

**Academic Text Features and Reading  
In English as a Second Language**

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## **Academic Text Features and Reading in English as a Second Language**

Reading of academic text materials for problem solving purposes involves knowledge and skills which are complex. The development of these skills among adult learners of English as a Second Language (ESL) is interesting on both practical and theoretical grounds. In this paper we discuss some characteristics of texts and naturally occurring academic passages that influence a reader's ability to orient to a text and to extract meaning from passages for the purpose of answering questions, creating summaries, or performing other learning tasks. The text analysis work described here is part of a program of empirical research investigating reasoning and reading comprehension processes among college level, second language learners in fields such as introductory oceanography, psychology, and other academic areas. This paper arises out of issues we had to consider in attempting to investigate the reasoning and text comprehension of ESL students. Our purpose in the paper is to identify some important kinds of text features that might help steer ESL and non-ESL readers through the distribution and organization of ideas in a text. Accordingly, we are here most interested in text features that serve high-level semantic functions. That is, we are interested in units of language and other printed cues that convey key concepts, and in addition, complete ideas or thoughts at the sentence-level and beyond.

Our approach to text description is informed by three theoretical perspectives that are complementary. First, congruent

with cognitive research on reading comprehension and metacognition, we hypothesize that a student's reading performance and reading strategies for the purpose of answering questions need to be understood as an interaction among learner, task, and text characteristics (Goldman & Durán, 1988; Brown, Armbruster, and Baker, 1986). Central to this perspective is the idea that a good reader monitors his or her comprehension and that when comprehension difficulties arise, the reader enacts reading strategies to compensate for these difficulties. Second, in agreement with emerging research on assessment of second language proficiency, we find it helpful to consider the full range of language recognition and comprehension skills needed by readers (Canale and Swain, 1980; Durán, Enright & Rock, 1985). These skills include an ability to recognize and understand how meaning is cued by graphemic codes (e.g. punctuation,), lexical and grammatical structures, and by discourse features signalling introduction, organization, and development of information. We also consider the skill of good readers to recognize and understand additional semantic cueing devices of a text which augment or go beyond the literal language of a text. In this light, we consider, e.g. a reader's ability to recognize the purpose and function of tables, graphs, text boxes, margin notes, etc. and the information that they convey about an academic subject.

A third theoretical view we find informative stems from anthropological and ethnographic studies of literacy. Ethnographic studies (e.g. Heath, 1983 and Scribner & Cole, 1981) indicate that people's *in situ* reading of a text involves strategic behaviors which are highly context-sensitive to text features and to the social,

everyday demands of tasks involving reading. Thus, in portions of our research we are interested in learning how an individual actually interacts with a text as they perform or prepare for academic tasks. We are especially interested in discovering strategic behaviors that embody a parsimonious but powerful set of cognitive operations accounting for reading behavior during problem-solving tasks such as answering questions (Goldman and Durán, 1988).

We believe that an approach building on the areas cited can contribute in an important fashion to a more realistic and comprehensive understanding of what readers do as they actually perform academic learning tasks using textual materials. The approach appears especially useful for studying second language learners' reading skill development because it can prove sensitive to a wide range of compensatory strategies applied by readers as they encounter comprehension problems. We note in passing, however, that our approach applies just as much to native readers of a language as to second language learners.

We will discuss several general text characteristics which we believe can have a significant impact on second language students' comprehension and inferential operations drawing on the perspectives cited above. First, we will discuss ESL students' strategies for studying texts in everyday activities. We then go on to discuss text organization, formatting and language characteristics of texts.

### **ESL Students' Study Strategies**

ESL readers need to judge how their overall capacity to comprehend English texts and prior knowledge of a content or skill area affect their strategies for studying from a text. Evidence exists that

students from non-English backgrounds are sensitive to the impact of limited verbal skills on their ability to perform academically. Duran, Enright, and Rock (1985), for example, found that Hispanic college candidates' self-judgments of ability to read, write, orally comprehend, and speak English were significantly correlated with students' SAT verbal test scores. However, the impact of English proficiency on the reading strategies employed by adult ESL college students has not been investigated intensively. Anecdotal evidence suggests that ESL students rely on a number of compensatory reading strategies. Commonly cited strategies include reading assisted by an English dictionary, asking peers for help with English vocabulary terms, rereading materials several times, and deliberate slow reading to insure through comprehension.

We lack research, however, on how specific compensatory reading strategies of ESL students interact with the characteristics of texts themselves. Anderson and Armbruster (1985), while concerned with monolingual students, offer informative suggestions that can be extended to breach this gap. They outline characteristics of "good" as opposed to "poor" texts that can help learners acquire knowledge. According to Anderson and Armbruster good texts have the advantages outlined below:

1. Criteria for studying will be clearer to students because
  - a. The titles, headings and topic sentences help the student identify the questions that the text is answering.
2. Focusing attention will be easier because

- b. Each idea unit in the regular text is important, in that it contributes to an answer and/or a question.
  - c. The idea units that have a high probability of being nonessential are clearly marked by being in a box.
  - d. The hierarchical structure of the text and high degree of unity make it easy and efficient for students to locate a specific text unit. Entire chunks of irrelevant text can be easily identified and skipped over.
- 3.
- e. The high degree of coherence, structure, and unity will enable the students to select and rapidly engage in a variety of activities to promote encoding such as outlining, mapping, underlining, and notetaking. Even the more time-consuming activities proceed very smoothly when using text with these characteristics.
  - f. The hierarchical structure of the text encourages students to use a top-down, higher-level perspective when reading and organizing ideas from the text. This perspective is contrasted with a bottom-up one in which the students are not sure where the author is going, and must put the puzzle together in an inefficient, piecemeal fashion (p. 175).

The qualities of a good academic text suggested by Anderson and Armbruster allude to some of the learning demands that may be faced by students in learning tasks. For example, these demands may include understanding implicit or explicit questions answered by a text, and comprehending the immediate usefulness and function of individual idea units as they occur. They also cite metacognitive learning

strategies used by students as they interact with a text, e.g., outlining, mapping, and notetaking, and the recognition and acquisition of high-level organizers for text information.

Text characteristics and text processing strategies such as those cited by Anderson and Armbruster are embedded within specific learning activities and they point to the importance of an ESL student's ability to interpret the nature of a learning activity effectively. While there is only a limited empirical research base on the strategies ESL students use in reading a text given its characteristics, further research can be motivated by discussing some of the most salient characteristics that ought to affect reading.

These characteristics include the organizational formatting of a text, the use of printing and type-font conventions as signalling devices for meaning, and the use of discourse and other linguistic conventions to encode text information. The range and variety of signaling devices occurring in texts is evident in the following list developed by Lorch (in press).

Titles

Headings and Sub-headings

Repetition of content, including

Exact repetition of a statement for emphasis

Certain types of preview statements

Certain types of summary statements

Function indicators, including:

Pointer words (e.g., "thus")

Pointer phrases (e.g., "in summary")

Acquisition For	
NAME	<input checked="" type="checkbox"/>
DATE	<input checked="" type="checkbox"/>
UN	<input type="checkbox"/>
Substitution	<input type="checkbox"/>
By	
Distribution/	
Acquisition Codes	
Acquisition for	
Dist	Special

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Pointer sentences (e.g., "Let me summarize what has been said")

Relevance indicators, including:

Pointer statements or phrases emphasizing particular content (e.g., "Let me stress that...")

Enumeration devices (e.g., numbering points in an argument)

Typographical cues, including:

Underlining

Change of appearance in print (e.g., boldface, color)

Distinguishing content spatially (e.g., indentation, centering)

Lorch also summarizes the findings of psychological studies of the effects of these signaling devices on reading and meaning processes. The general findings of research indicate that memory of and attention to text information is positively affected by signaling devices among monolingual subjects. Goldman (1988) has reported that ESL college students are also subject to the positive effects of signals. As well, ESL students are sensitive to the usage conditions of logical relation indicators, i.e. connectors. (Goldman & Murray, 1989; MacLean & d'Anglejan, 1986).

We now turn to a more specific discussion of these and other signalling devices that ought to be expected to affect the reading processes of ESL students.

### **Text Organization and Formats**

Textbooks have parts and follow formatting and layout conventions that aid readers in getting at text meaning (Duffy and

Waller, 1985). While we are readily aware that the principal ideas in a text are presented in language, we are also aware of additional ways in which meaning is conveyed in a text. For example, we notice that a text can have parts such as a title page, table of contents, preface, introduction, chapters, glossaries, appendices, and an index. These parts of a text serve as organizers for the overall meaning available in a text and good readers would be expected to recognize these formats and their functions. The table of contents, for example, provides a conveniently accessible outline of the overall organization of a text into chapters, sections and subsections, and the pages corresponding to these text segments. The importance of the table of contents as an organizer of text information and, as well, as an organizer of a field of knowledge is underestimated by the novice studying a text for the first time. The apprentice learner is unable to grasp the significance of the table of contents as a high-level framework depicting organization of knowledge in a field compiled by an expert teaching this knowledge. But, perhaps, this makes sense. The practical function of a table of contents is to assist the learner in locating pages in a text corresponding to various sections of information. Some text formats are of special importance to ESL readers. For example, we know that ESL students are more likely to encounter vocabulary recognition difficulties than other students (Durán et al., 1985), hence, knowing how to locate and use an index and glossary for such students could be extremely helpful.

Within text chapters there are other forms of text organization that can guide readers' access to meaning. Such organizers include, e.g., sections and subsections within a chapter, sideheaders, text boxes,

graphs, tables, and figures. Sections and subsections of chapters are structured around the main topics to be covered in a chapter.

It is common--but not universal--that students' reading and classroom assignments focus on material found within specific sections and subsections of a text chapter. It is at this level of text organization that we become most interested in the cognitive and linguistic strategies applied by students as they work academic assignments such as answering questions. The notion that chapters, sections and subsections of a text are organized around key material to be learned would appear equally salient to students regardless of their language background. Ability to find portions of text pertinent to academic assignments, however, may differ for ESL and native-English speaking students and may interact with a student's prior knowledge of subject matter when active searching for text information is required in order to answer questions (Goldman and Duran, 1988). According to the model developed by Goldman & Durán (1988), the question answering task involves several processes. Students must interpret the linguistic statement of a question in terms of a question topic; they must identify relevant information provided by the text as a function of knowledge they already possess; further, they must identify what is the nature of the unknown information required in a response to a question.

Text boxes are typically used to present supplementary information that cannot be adequately covered in the main body of a chapter section. Graphs, tables, and figures and their labels serve a number of functions that are often central, rather than supplementary to text comprehension. Perceptually they serve as visual aids to

comprehension and they may illustrate or expand upon information conveyed linguistically in the main body of a text. In technical texts these aids are often used to visually exemplify the operations of principles or to display relationships of a quantitative nature among variables in some system under discussion in a text section. Labels accompanying these learning adjuncts are themselves informative. Students need to recognize the ways in which labels summarize the key concepts and relationships depicted in these learning adjuncts.

### **Type-Font Conventions**

Occurrence of the foregoing formats and structures in a text is accompanied by variations in type font conventions that provide information. Each academic text establishes its own conventions for the way in which type is manipulated to encode information. Examples of conventions might include use of italics, quotation marks, or bold-face type when new terms or concepts are first introduced and defined. Still another set of conventions is the use of larger size, bold face type and capital letters in the statement of chapter titles, section headers, and sideheaders. Recognition of these graphemic conventions to assist access to text information appears to rely on perceptual recognition strategies that are distinguishable from strategies in the decoding of natural language. Type-font conventions serve a different semiotic function. They signal through physical appearance information about text organization that can help a learner in orienting to text meaning and value to learning. We know little of how these conventions affect learning, though much knowledge about how to design and manipulate typing conventions is exercised in the production of textbooks (Duffy and Waller, 1985).

The ability of ESL as opposed to non-ESL readers to recognize the functions of type-font conventions is more related to the academic, cultural experiences of learners than to their ability to understand a second language. And the same can be said for the ability to understand other formatting conventions for organizing text information. Nonetheless, these features of a text must be considered in developing an adequate understanding of ESL students' reading strategies. Because of cultural and social experience differences, there is always the possibility that ESL readers may not be familiar with the utility of these conventions as aids to learning.

It is interesting to note that the semantic significance of text formatting conventions and type font conventions to text understanding is not typically considered worthy of systematic attention in ESL courses. Indeed it was not until the early 1970's that such concerns were considered relevant for a comprehensive description of language processing skills. In recent years concerns for skill in processing graphemic conventions in general has emerged in descriptive frameworks for describing the communicative competence skills that ESL students must acquire (Canale & Swain, 1980).

We next consider some of the discourse and natural language characteristics of texts that are important for ESL readers to recognize.

### **Discourse and Linguistic Conventions**

There is no unified and comprehensive theory for the structure of English discourse, or the structure of discourse in any language, for that matter. There is a trend in recent years, however, to focus attention on the centrality of the communicative functions served by

discourse and for how these functions are signalled in natural language. Brown and Yule (1983), for example, adopt this perspective and suggest two major functions: transactional and interactional. The transactional function best depicts the function of textbook language, namely the expression and transmission of content knowledge. The interactional function of discourse, on the other hand, has as its primary purpose the negotiation of interpersonal social relationships among interlocutors.

Transactional discourse is characterized by assumptions or maxims about the intentions of a writer relative to a reader, and in this sense, it has a social kernel, though it is not intended to dynamically regulate on-going social relations among active interlocutors. We do not have a clear and unambiguous model for these assumptions and conventions in the case of academic texts, but they appear to include certain beliefs. A first assumption is that text discourse is topic-centered and that the text of a chapter, its sections and subsections are intended to elaborate knowledge about a topic. Two additional assumptions are the belief on the part of the reader that texts present veridical information, and the belief that as text material is presented it consists of coherent and logically consistent elaborations of knowledge about a topic.

The extent to which these assumptions vary across languages and how different languages realize discourse conventions is the subject of study of the field known as contrastive linguistics (Kaplan 1966). While we are unable to explore this area here, it is worthwhile noting that there is evidence suggesting that there are culturally-based tendencies and preferences in the way expository discourse can be

organized. This has implications for better understanding the reading strategies of ESL students. Research is needed on how the language background of such students affects students' ability to sense the discourse structure of English-language texts.

Given the foregoing caveat, we will proceed to mention three classes of English discourse-level phenomena that need to be recognized by ESL readers and that merit further research regarding their affects on comprehension processes. These phenomena include: recognition of topic development and background knowledge, subordination, and the occurrence and use of logical connectors. All of these phenomena are interrelated and occur in discourse. Nonetheless, each merits separate attention in light of the academic reading comprehension skills that ESL students are expected to develop.

### **Topic Development and Background Knowledge**

Cognitive psychologists have used the term "macrostructure of a text" to refer to the underlying semantic representation of the main ideas or topics and the way they are globally elaborated by a text (Kintsch & van Dijk, 1978). The macrostructure of a text is distinguished from its microstructure. The latter term refers to the way in which each separate idea in a text is sequentially connected to preceding ideas.

Academic texts in English at the college level are characterized, typically, by a macrostructure resembling a linear outline. A chapter focuses on a central topic and the separate sections and subsections of the chapter go on to develop information about the topic. This development proceeds sequentially and in a cumulative manner. Comprehension of a given section or subsection of text presupposes

comprehension of previously occurring sections and subsections, and often previous chapters of text.

The fact that academic texts introduce and elaborate topics in a linear-outline manner does not imply that the underlying knowledge acquired by the learner is structured in memory in this manner. Cognitive psychologists investigating discourse comprehension, for example, suppose that memory for text is better represented as a network of interconnected propositions derived from a text and stored in long-term memory (e.g., Beaugrand, 1980; Kintsch & van Dijk, 1978; Rumelhart, 1977).

The ultimate goal of learning from a textbook is to assist the reader in acquiring a mental representation in long-term memory for the knowledge conveyed by a text. The relevant background knowledge stored in long-term memory that a learner brings to the task of reading a text and to completion of text assignments is critical. In essence, the learner must activate this knowledge and use it in the act of comprehension to build a representation of new information conveyed by a text. Further, the representation that is built must be made useful by the development of procedural knowledge aiding the learner in applying new knowledge toward the solution of problems and assignments drawing on this knowledge.

One of the most important issues in research on ESL students' academic reading skills concerns the extent to which their background knowledge--especially previous study of an academic topic--affects their reading strategies and sensitivity to topic development in a text. Hypothetically, an ESL reader with a strong command of a topic will be able to recognize the macrostructure of text and will be able to



activate corresponding content knowledge accordingly. The processing of text by such a reader in light of his or her limited English proficiency may be very different from the processing of text by another reader with limited English proficiency, but with a lack of familiarity with an academic topic. The ESL student with a strong topic familiarity should be able to process text better in a top-down manner than the ESL student with a weak topic familiarity. Both types of students will be able to process text in a bottom-up manner subject to their command of English, but the student with a weak topic familiarity may need to expend more effort and have more difficulty integrating text information into an underlying knowledge representation maintained in long-term memory (Goldman & Durán, 1988).

There are certain language mechanisms that can make more apparent the microstructure, and in some cases the macrostructure. Lorch (in press) referred to these as function indicators; Meyers' (1975) rhetorical devices are function indicators. Furthermore, the sentence-level organization of information carries meaning regarding the meaning relations among the informational elements. That is, one idea may be subordinated to a second. The subordination per se communicates information about appropriate topic-elaboration. Subordination and logical connectors are discussed in the next section.

### **Subordination**

Subordination relates to how language is used to introduce and develop topics and how topics are connected across stretches of text. This issue pertains to the semantic microstructure of a text and to how sentence and clause units are structured and connected syntactically to

express the microstructure. As a reader encounters text sequentially, he or she must recognize the topic under discussion and must recognize elaborations of the topic. In this process readers must distinguish previously given or foreground information from new information and the relationships between the two (Perfetti & Goldman, 1974).

Discourse level text involves multiple sentences. Individual sentences may involve a simple clause consisting minimally of a subject and a main verb. Complex sentences consist of a main clause and accompanying dependent clauses. The latter are not typically independent sentences. Clauses and sentences have either a coordinate or subordinate relationship to each other. Coordinate clauses and sentences are of equal semantic rank in that they express independent information about a topic. As an example of two coordinate clauses, one an independent clause and the other a dependent clause, consider:

*This is due to the abundance of surface water [indep. cl.]  
and its remarkable thermal properties [dep. cl.].*

These two clauses have a coordinate relationship to each other because they present independent information about a topic: mildness of the earth's climate.

Two clauses have a superordinate-subordinate relation when one clause, the superordinate clause can stand alone as complete sentence, but is accompanied by another dependent clause to form a compound sentence. The dependent clause cannot stand alone as a sentence and it provides semantic information about a topic that can be understood only in relation to the semantic information provided in the

superordinate clause. Subordinate clauses often take the form of an adverbial clause connected semantically to a superordinate clause by means of a logical connector. Consider for example the compound sentence:

*Although roughly equal in thickness, the oceans are 90 times more massive than the atmosphere.*

In this example, the adverbial clause "*Although roughly equal in thickness*" has a subordinate relationship to the main independent clause which follows. That is, it does not make sense on its own, but must be interpreted as semantically dependent on another clause. The adverbial clause references the specific topic of the sentence (equality in thickness of the oceans and atmosphere) and the subsequent independent clause contributes new information about the topic. The logical connector "*although*" at the outset of the adverbial clause signals that a semantic contrast or oppositional relationship is being presented between two ideas.

To understand an academic text, readers must recognize the occurrence of subordinate relationships among clauses. Further, readers must be able to recognize adverbial clauses and the use of logical connectors to establish explicit semantic relationships among the ideas expressed in clauses. The ability to comprehend written language in this manner requires a high-level of English language proficiency. It requires extensive knowledge of English sentence-level syntax and also a knowledge of how the syntactic structure of English operates to signal semantic relationships across clausal units. It also

requires extensive knowledge of how logical connectors establish relationships among ideas expressed by clauses.

Before turning to a more detailed discussion of functions of logical connectors, it should be noted in passing that subordination can encompass additional purposes in sentence syntax, co-occurring with their functions to mark given-new, topic-comment, and logical functions at the discourse level (Greenbaum, 1989). For example, subordinate clauses may operate as noun phrases as in

*Saving energy will help our balance of payments*

or as modifiers and complement clauses, as in

*Drugs that are used in chemotherapy change a patient's healthy cells as well.*

To comprehend a text, students must recognize the occurrence of these subordination functions, noting their within sentence syntactic function, as well as their function in developing a text topic and in showing logical relations to other text information.

### **Logical Connectors**

Logical connectors are words or terms that semantically connect ideas conveyed in separate phrases, clauses, or sentences. As mentioned in the previous section their use is intimately related to the way given and new or topic and comment information are marked in superordinate and subordinate relationships to each other. These functional units of language are an important subclass of cohesive devices in English. Halliday and Hasan (1979), under the rubric of conjunctive cohesion, distinguish four types of transitional expressions: additive, adversative, causal, and temporal.

Additive transitional expressions signal that ideas across clauses add to information about a topic. They are used to signal addition of information, introduction of new information, relationships of similarity, etc. Additive transitional expressions are underlined in the following sentences taken from an oceanography text:

*For instance, if air at 25°C were 3.1% water vapor, then the absolute humidity would be 3.1% whereas the relative humidity would be 100%.*

*If air at 100% relative humidity is cooled, then it becomes super saturated and the excess moisture precipitates.*

*Furthermore, in spite of our sentiments during the rainy season, the atmosphere holds only a thousandth of a percent of the hydrosphere's water.*

Adversative logical connectors signal conflict, contradiction, concession, etc. among ideas. Examples of these connectors are underlined below in sample sentences occurring in the oceanography text.

*In spite of its low water content, the atmosphere serves as an important agent in the transfer of water from one reservoir to another.*

*The ocean loses water to the atmosphere via evaporation, but gains it back through precipitation, run-off from the land, and melting of ice.*

*Although the required amount of sensible heat does not depend on the initial temperature of the air, the amount of latent heat does.*

Causal logical connectors are used to signal cause/effect, reason/result, and similar causal or logically contingent relationships. Examples of these expressions are underlined below.

*Due to collisions between molecules, their motions are quite chaotic.*

*We call air "saturated" if it is holding as much water as it can.*

*Over the continents, the precipitation exceeds evaporation, and so some of the water must be returned to the oceans via the rivers and underground flow.*

Sequential logical connectors are used to signal an explicit chronological or logical order among ideas and expressions of summation of ideas. Below are examples:

*In addition to low rates of evaporation, the land has two special talents for coaxing moisture out of the air. First it is higher.*

*Next, a special talent that the land has to coax water from the air is its large daily and seasonal temperature fluctuations.*

*As the above example shows, at higher temperature, relatively larger fractions of the added heat can go into evaporating water.*

Celce-Murcia and Larsen-Freeman (1983) suggest that ESL students' command of logical connectors is a good indicator of students' syntactic maturity. They discuss the difficulty of ESL students in learning how to use these connectors correctly and in understanding how to properly position connectors at the start of a first clause, between two clauses, and at the end of a second clause.

### **Directions for Research and Preliminary Findings**

The explicit semantic functions of logical connectors make such connectors amenable to research. Goldman and Murray (1989) investigated ESL and native English speaking students' ability to discriminate the appropriateness of alternative connectors in the text. In one of these studies (Goldman & Murray, 1989, Experiment 1) students were presented paragraph-length texts with deleted terms corresponding to a logical connector. Students were asked to pick a correct connector for each slot given four choices representing an additive, adversative, causal, or sequential connector. The results of the study showed that native English speakers were more frequently correct than ESL students, but that both groups of students showed similar patterns of correct and incorrect responses. Students were most often correct when additive or causal connectors were required. Students also showed a propensity when they were wrong to more frequently choose causal alternatives than other incorrect connector types.

However, there was a notable difference between native English and ESL students' confidence ratings in their responses. Native English students were more confident of their adversative and sequential correct choices than of their correct additive and causal choices. ESL students, on the other hand, did not show such differentiation. All students were more confident of correct than of incorrect responses. An accompanying analysis of verbal protocol response justifications suggested that incorrect responses stemmed from failure of students to understand the required semantic relation appropriate to a text slot and failure to select a connector fitting the inferred but incorrect relation from among the alternatives for that slot. In summary, ESL students had greater difficulty in understanding how connectors functioned when embedded in a text than did native English students; further, the ESL students were not as good as the native English in distinguishing when they were correct versus incorrect.

The familiarity of ESL students with English can affect students' sensitivity to the organization of text normally signaled by logical connectors. Goldman (unpublished) found that failure to mark the occurrence of a second point in a text by a sequential connector such as "second" led to poorer recall of the second point by both native English and ESL students. However, the ESL students represented two levels of English proficiency. The ESL students who were least proficient in English were most prone to show the discrepancy between marked and unmarked points.

Results of the studies cited suggest that native English and ESL students may encounter many similar difficulties in processing academic texts, though the weaker English proficiency of ESL students



further undermines their effective comprehension of texts. There is a clear need for further research and it seems likely that such research will contribute to a more precise understanding of the English language and reading comprehension of ESL students.

## REFERENCES

- Anderson, T. H., & Armbruster, B. B. (1985). Studying strategies and their implication for textbook design. In T. M. Duffy and R. Waller (Eds.), *Designing usable texts* (pp. 159-177). Orlando, FL: Academic Press.
- Brown, A. L., Armbruster, B.B., & Baker, L. (1986). The role of metacognition in reading and studying. In J. Orasanu, (Ed.), *Reading comprehension: From research to practice* (pp. 49-75). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Brown, G., & Yule, G. (1983). *Discourse analysis*. New York: Cambridge University Press.
- Canale, M., & M. Swain (1980). Theoretical bases of communicative approaches to second language teaching and testing. *Applied Linguistics*, 1, 1-47.
- Duffy, T. M., & Waller, R. (Eds.) (1985). *Designing usable texts*. Orlando, FL: Academic Press.
- Durán, R. (1985). Influences of language skills on bilingual problem solving. In S. F. Chipman, J.W. Segal, and R. Glaser, (Eds.) *Thinking and learning skills: Vol. 2. Research and open questions*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Durán, R., Enright, M., & Rock, D. (1985). *Language factors and Hispanic freshmen's student profile*. New York: College Entrance Examination Board.
- Goldman, S. R. (1988, December). *The role of sequence markers on reading and recall: A comparison of native and nonnative English speakers* (Technical Report). Santa Barbara: University of California.

- Goldman, S. R., & Durán, R. (1988). Answering questions from oceanography texts: Learner, task and text characteristics. *Discourse Processes*, 11, 373-412.
- Goldman, S. R., & Murray, J. (1989, August). *Knowledge of connectors as cohesion devices in text: A comparative study of native English and ESL speakers* (Technical Report). Santa Barbara: University of California.
- Greenbaum, S. (1989). *A college grammar of English*. London: Longman Group, Ltd.
- Halliday, M.A.K. and Hasan, R. (1976). *Cohesion in English*. London: Longman Group, Ltd.
- Heath, S. B. (1983). *Ways with words*. Cambridge: Cambridge University Press.
- Kaplan, A. (1964). *The conduct of inquiry: Methodology for the behavioral sciences*. San Francisco, CA: Chandler.
- Kintsch, W., & Van Dijk, T. A. (1978). Toward a model of text comprehension and production. *Psychological Review* 85, 363-394.
- Lorch, R. (in press). Text signaling devices and their effects on reading and memory processes. *Educational Psychology Review*.
- Perfetti, C.A., & Goldman, S. R. (1974). Thematization and sentence retrieval. *Journal of Verbal Learning and Verbal Behavior*, 13, 70-9.
- Scribner, S., & Cole, M. (1981). *The psychology of literacy*. Cambridge, MA: Harvard University Press.

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